PERFORMANCE OF BROILERS FED ON COWPEA (*VIGNA UNGUICULATA*) MEAL SUPPLEMENTED WITH SELECTED AMINO ACIDS.

BY

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UNZA, 2013.

THE UNIVERSITY OF ZAMBIA

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A THESIS

SUBMITED TO THE SCHOOL OF AGRICULTURAL SCIENCE IN PARTIAL FULFILLMENT OF THE REQIUREMENT FOR THE DEGREE OF BACHELOR OF AGRICULTURAL SCIENCE

UNZA, LUSAKA.

2013

DECLARATION

I, Mwale Stanslous, D declare that this Bachelor of Science in Agricultural Sciences (BSc. AG) thesis represents my own work and that the work contained herein has not been submitted for an award of an academic degree at this or any other university. All sources of information have been acknowledged in the form of citations and references.

Sign.....Mwale.. Date...23/09/13..

DEDICATION

I dedicate this report to my late mother, Mrs. Sidonia Phiri Mwale, who passed on in 1994 when I just started my education. She always wanted the best for me and the legacy she left has taken me this far. Wish she was here to see this dream come true. Deeply miss her.

ABSTRACT

The research was carried out to evaluate performance of broilers fed on cowpea (*vigna unguiculata*) meal supplemented with selected amino acids. The experiment was conducted at the University of Zambia; School of Agricultural Sciences Field Station for a period of six weeks in a Completely Randomized Design (CRD), with 3 treatments and 3 replicationsTreatment 1: Broiler chickens fed a soya bean meal with crude protein of 22% starter feed and 19% finisher feed without cowpea and threonine Supplementations. The feed were formulated using ZABS recommendations.

Treatment 2: Broiler chickens fed a cowpea meal with crude protein of 19% starter feed and 19% finisher feed without soya bean meal and threonine supplementation.

Treatment 3: Broiler chickens fed a cowpea meal with crude protein of 19% starter feed and 18% finisher feed without soya bean meal but supplemented with threonine.

The results obtained on the present study indicated that there are no significant difference in live weight and Feed Conversion Ratio while there were significant differences in feed intake among the treatments.

ACKNOWLEDGEMENT

The successful completion of this report was made possible by the contributions and efforts of various individuals and organizations entities. First and foremost, i would like to thank and acknowledge Ms. Musukwa for her tireless and supportive supervision and guidance throughout the compilation of this report and entire project. The priceless assistance she rendered to me is worth remembering for a life time. Secondly I thank all my family members, for the continued financial, social support and confidence they have had in me throughout my academic life, I feel indebted to them. To all my academic friends, I am humbled for all the contributions made, you gave me the confidence to reach my goal. I would also like to thank the Government of the Republic of Zambia (GRZ) for the sponsorship, the University of Zambia (UNZA) animal science laboratory and the field station for giving me the necessary facilities for analyzing samples and carrying out the experiment respectively. Finally, I thank God, for seeing me this far to achieve my dream.

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ABBREVIATIONS AND ACRONYMS

Ash (%)	Percent Mineral Content
C.V	Coefficient of Variation
Ca (%)	Percent Calcium Content
CF	Crude Fiber
CP (%)	Percent Crude Protein
CRD	Completely Randomized Design
DM (%)	Percent Dry Matter
EE (%)	Percent Ether Extract (Crude Oil)
FCR	Food Conversion Ratio
M (%)	Percent Moisture Content
ME	Metabolisable Energy
N	Nitrogen
NH_3	Ammonia gas
NRC	National Research Council
NSP	Non Starch Polysaccharides
ZABS	Zambia Bureau of Standards

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CHAPTER 1

1.0 INTRODUCTION

1.1 General

Protein is one of the critical nutrients in animal production and it accounts for most of the cost in feed formulations in livestock enterprises. In Zambia and other African countries this is even worse due to lack of animal protein sources such as fish and blood meals and the processing industries. This is due to inability to produce animal sources and technologies of processing them. With the ever increasing animal production in the quest to feed growing human population, there is high demand of protein both of plant and animal origin. The principal source of protein used in feed formulations in Zambia and other parts of the world is soya beans. Soybean meal is a major source of plant protein in animal production and this has made it to be relatively expensive and hence increasing production costs of livestock *(Chakam, 2010)*.

The animal industry can be defined as an industry producing proteins of higher value (meat, milk) from less expensive protein sources (vegetable proteins such as soybean meal). To meet the growing demand for protein worldwide, it is essential to improve the efficiency of conversion of proteins from feed to meat. Amino acids for feed now play indispensable roles in improving the efficiency of animal protein production, and contribute to increasing protein supply. Agriculture researches are stretched to lower production costs and waste products, primarily nitrogen and phosphorus entering the environment. Feed costs and level of nitrogen ammonia entering the environment are reduced when crystalline amino acids are used in precision feed formulation (*Bregendahl et al. 2000*).

The most limiting amino acids in broilers are methionine, lysine and threonine in this order. Most feeds are supplemented with methionine and lysine except threonine which is the third limiting amino acid. Some researches done from different parts of the world have shown that including threonine in feeds increase protein utilization by the birds and lower nitrogenous waste brought by feed crude protein excesses (*Ferguson et al. (1998*).

However, there is still a common belief that whenever crude protein levels are lowered, the Performance of the animal is negatively affected. This is a result of a number of studies where researchers have lowered crude protein levels beyond practical formulation levels, (*Netoet al., 2009; Bregendhahletal., 2002*) and then failed to supplement all limiting amino acids to sufficient levels. In some cases crude protein levels were lowered without supplementing amino acids other than lysine and methionine. Research were practical diets with reasonable crude protein reduction and maintenance of essential amino acids intake showed no significant differences in growth rate, body composition or breast meat yield, *(Hai and Blaha, 1998; Hai and Blaha, 2000; MacLeod et al. 2003).*

The World today is looking for lower cost ways of formulating poultry feeds by understanding the amino acids required by the birds and the level of crude protein in feed material. Nutritionists have found out that poultry can be raised by supplying the limiting amino acids in low crude protein.

One of the potential local plant sources of protein in Zambia is cowpea. Cowpea (pulse crop) have been are underutilized because of their low sociocultural status.

Threonine, a third limiting amino acid is an indispensable amino acid for body protein deposition and growth, as a result, deficiency in threonine affects the utilization of dietary lysine and consequently animal growth. L-threonine plays a significant role in protein synthesis and other biological functions such as gut integrity and immunity. Therefore, a deficiency in threonine leads to disorders in the digestive physiology which can as a result increase the frequency of digestive problems and poor growth rate. This demonstrates that threonine requirement varies depending on the relative importance of these different functions and it is therefore important to determine the threonine requirement which corresponds to each physiological stage to improve the balance and efficiency of feeds (*Applegate, 2008*).

1.2 Problem Statement

There has been overdependence on soya bean meal as a source of protein due to lack of alternative source of protein in Zambia and other parts of the world which has led to high production costs in the poultry industry. Utilization of vegetable legumes is one way of lowering feed costs *(Sathe and Salunkhe, 1981).*

According to *Robinson and Singh (1997)*, the price of soybean meal is forecasted to increase higher on the international market due to the high demands in China and the emergent countries of Asia. As a result, there is the risk that soya beans as a source of protein for poultry would become too expensive and scarce in the years to come, particularly in low-income African countries south of the Sahara which include Zambia. It is therefore imperative that Zambia searches for good substitute feedstuffs for soya beans which are readily available locally and cheaply and also adopt new research of balancing limiting amino acids in feed formulation that jut balancing crude protein. Grain legumes such as cowpeas could be good substitute for soybean meal, as they are known to have a similar amino acid profile *(Wiryawan 1997)*.

1.2 Objectives

1.2.1 Overall objective

The overall objective of this study was to evaluate the performance of broilers fed on cowpea (*vignaunguiculata)* meal supplemented with selected amino acids.

1.2.2 Specific objective

Specifically the study was aimed to;

i. To determine the growth rate, feed consumption, feed conversion ratio (FCR) of broiler chickens fed on Cowpea meal, as protein source, supplemented with selected deficient amino acids.

1.3 Research Hypothesis

The research hypothesis was;

- H_o: There is no significant difference in growth rate, feed consumption in broiler chickens on Cowpea meal supplemented with selected amino acids.
- H_a: There is a significant difference in growth rate and feed consumption in broilers fed on Cowpea meal supplemented with selected amino acids.

1.4 Justification

Cowpea has the nutrient and energy concentrations which compare well with those of soya beans, with similar amino acid profiles *(Ravindranand Blair, 1992)*, and are often less expensive. Although the protein level of cowpeas shows great variation (*Canon and Carre, 1989)*, they can offer an alternative to lipid extracted soya oilcake meal.

According to *Robinson and Singh (1997)*, the price of soybean meal is forecasted to increase higher on the international market due to the high demands in China and the emergent countries of Asia. As a result, there is the risk that this traditional source of protein for poultry would become too expensive and scarce in the years to come, particularly in low-income African countries south of the Sahara. It is, therefore, necessary to search for good substitutes using readily available local Feed stuffs.

Grain legumes such as Cowpea can replace soya beans as they contain similar amino acids profile *(Wiryawan 1997)*. It has lower crude protein averaging 25%. Its ability to supply adequate protein can therefore be achieved through supplementing it with deficient limiting amino acids. The concerns of high levels of nitrogen excreted in poultry fecal matter can be addressed by adding sufficient level of the most limiting acids to the low crude protein sources. This will also reduce the cost of poultry production through the reduction of crude protein in plant protein sources.

Cowpeas are heat- and drought- tolerant crops *(Apata and Ologhobo, 1997)*, requiring low input costs and are well adapted to the arid agronomic areas *(Nell et al,1992)*. Cowpeas as well like other peas can be excellent sources of dietary protein in animal nutrition *(Igbasan and Guenter, 1997)*, especially where animal proteins are in short supply and expensive *(Wiryawan and Dingle, 1995)*.

CHAPTER 2

1.0 LITERATURE REVIEW

1.1 Cowpea as Source of Protein

The cowpea *(Vignaunguiculata)* is an important grain legume in tropical and subtropical regions where a shortage of animal protein sources is often experienced. They are heat- and drought- tolerant crops *(Apata and Ologhobo, 1997)*, requiring low input costs and are well adapted to the arid agronomic areas of South Africa *(Nell et al., 1992)*. Cowpeas as well as other peas can be excellent sources of dietary protein in animal nutrition *(Igbasan and Guenter, 1997)*, especially where animal proteins are in short supply and expensive *(Wiryawan& Dingle, 1995)*. The nutrient and energy concentrations of peas compare well with those of soya beans, with similar amino acid profiles *(Ravindran& Blair, 1992)*, and are often less expensive. Although the protein level of cowpeas shows great variation, they can offer an alternative to lipid extracted soya oilcake meal *(Canon andCarre, 1989)*. The variation in protein level that is observed within species may be attributed to differences in genotypic and environmental factors, as well as to agronomic practices *(Ali-khan andYoungs, 1973.)*

Table 1: Chemical Composition of Cowpea

Component	Percent (%)
Dry matter	93.3
Crude protein	20.91
Ether extract	2.0
Crude fiber	3.4
Ash	4.1
Nitrogen free extract	62.89
Metabolisable energy (ME) (MJ/Kg)	13.4

Cowpeas are characteristically low in sulphur containing amino acids and high in lysine *(Coertze and Venter, 1996)*.

Similar to other grain legumes, recent studies have agreed that utilization of raw cowpea seeds was limited because it contain some non-digestible and anti-nutrient factors which affect broiler feed consumption and growth and so there need to detoxify before feeding to monogastric animals *(Igbasan and Guenter, 1997)*, *(D'Mello, 1995)*. These include protease inhibitors, non-starch polysaccharides (NSP), pectins and phenolic compounds *(Arora, 1995)*, which reduce protein quality and nutrient digestibility. Protease inhibitors impair the activity of pancreatic enzymes such as trypsin and chymotrypsin.

Broilers finished with cowpea had a higher carcass yield *(Defang et al., 2008)*. Likewise, sun-dried cowpeas successfully replaced 75% of soybean meal in broilers *(Lon-Wo et al., 2000)*. In both cases, feed cost was significantly reduced. Cowpea meal included at 16% in starter broiler diets had no negative effect *(Trompiz et al., 2002)*.

There is wide-spread belief that whenever CP concentrations are lowered, performance is negatively affected. *Burnham (2005* speculates that this belief came from researchers (such as *Neto et al., 2002; Bregendhahl et al., 2002)* who lowered CP concentrations beyond practical formulation and then did not supplement back with sufficient amounts of limiting amino acids other than methionine (Met) and lysine (Lys). Reductions in the non-essential amino acid pool together with supplying a more "ideal" amino acid profile in the diet can substantially increase the efficacy of overall N retention by the bird. On a practical basis, however, bird performance can be hindered by excessively lowering CP in diets due to a number of factors other than the reduction of CP itself. According to *Waldroup (2000)*, these factors can include: reduced potassium levels, altered ionic balance, lack of nonessential amino acids, imbalances among certain amino acids (e.g. branched chain amino acids), and/or potential toxic concentrations of certain amino acids.

The biological value of a feed protein depends on its amino acid configuration. Optimum animal performance such as feed intake and weight gain are achieved when the protein fed contains an ideal amount and proportion of all essential amino acids (ideal protein). Feeding diets based on animal protein show that the performance of the animals is significantly better than when feeding vegetable protein implying that animal protein is closer to an ideal protein than vegetable protein. Addition of a small amount of a certain essential amino acid to the vegetable protein diet improves the biological value of its protein measured by animal performance. The "Liebig barrel" illustrates this limitation of protein synthesis due to the lack of an essential amino acid. The concept of the first limiting amino acid states that: "If the rate of protein synthesis is lowered due to an inadequate supply of a limiting amino acid then increasing the limiting amino acid should increase protein synthesis" *(Mitchell et al., 1946)* and thereby improve animal performance.

In recent years a related feeding concept has been pursued. Conventional diet formulation is based on crude protein estimation with a safety premium in order to avoid amino acid malnutrition. Consequently higher excretion of nitrogen containing compounds is the result because protein supply is not matched as close as possible to the requirements. But increasing feed costs and environmental aspects have caused rethinking. It is possible to lower the crude protein content of a diet and provide the missing amino acids using supplemental amino acids. These diets are called low protein diets. This concept enables the producer to maintain animal performance while feeding a lower cost diet (*Burnham, (2005*).

Amino acids are now known to play very important roles in improving the efficiency of protein utilization in animal feeding. The requirements of amino acids in animals are well defined in various sets of recommendations such as those of National Research Council, (NRC), USA, Zambia Bureau of Standards (ZABS), Zambia etc. The amino acids requirements vary depending on the species and age of animals. For example in pigs the order is lysine, threonine and tryptophan while in poultry it is Methionine, lysine and threonine (*Havenstein et al., 1994; Williams et al., 2000*).

Supplementation of poultry diets with synthetic amino acids may improve the overall amino acid balance and enable a reduction in the crude protein level. Consistent demonstrations have shown that addition of Lysine and Methionine to broiler diets successfully reduces the crude protein level in diets to a point without adversely affecting the broiler performance *(Lipstein and Bornstein, 1975; Lipsteinet al., 1975; Waldroupet al., 1976; Uzu, 1982; Uzu, 1983)*. Amino acids should be supplied either in the form of protein or crystalline amino acids in feed to meet requirements of animals.

Crystalline amino acids are added to feed in the order of limiting amino acids, when the protein content of the feed is reduced (below the required level level). This is the same reason which led to the introduction of DL-Methionine and L-Lysine to animal feeds. Now, with a more economic supply of L-Threonine and L-Tryptophan available, use of amino acids has entered a new era, in which the use of third limiting amino acid poultry is taking off. For example, in the past two to three years, the annual growth rate of L-Threonine usage has been above 20 per cent. Since the protein level required by livestock is reduced further with the introduction third limiting amino acid, use of the first limiting amino acid will also be expanded. However, further reduction in crude protein cause the performance of chicken to decline even if all known amino acid requirements are satisfied *(Edmonds et al., 1985; Fancher and Jensen, 1989; Bregendahlet al., 2002; Si et al., 2004a; Jiang et al., 2005).*

2.2 Contribution to Protecting the Environment

There has been concerns of nitrogen excretion due to animal farming is posing a serious threat to human health through ammonia or nitrate/nitrite pollution in soil and water in the world today. This has led to livestock production units to be faced with more and more environmental regulations. Essential and a sufficient amount of non-essential amino acids must be supplied to a diet to prevent the conversion of essential amino acids into non-essential amino acid amino acids. Additionally, if the amino acids supplied are not in the proper or ideal ratio in relation to the needs of the animal, then amino acids in excess of the least limiting amino acid will be deaminated and likely used as a source of energy rather than towards body protein synthesis. This breakdown of amino acids will also result in higher nitrogenous excretions (*Ferguson et al. 1998*).

The best way to reduce N in poultry excreta is to lower the amount of CP that is fed by supplementing diets with amino acids. Reductions in the non-essential amino acid pool, coupled with supplying a more "ideal" amino acid profile in the diet can substantially increase the efficacy of overall N retention by the bird. On a practical basis, however, bird performance can be hindered by these lower CP diets due to a number of factors that tend to be associated with dietary CP and amino acid reductions (*Waldroup, 2000*).

Formulation based on bird amino acid requirements rather than CP can minimize N excretion by simply reducing total dietary N intake. For example, *Ferguson et al. (1998)* demonstrated with broilers that litter N could be reduced more than 16% when dietary CP was reduced by 2%, while maintaining similar levels of dietary amino acids (*Ferguson et al. 1998*).

2.3 Threonine

L-Threonine supplementation in poultry diets also contributes to a better utilization of lysine and of the feed in general. In association with L-Lysine, the use of L-Threonine makes it possible to further reduce the dietary crude protein content and, as a consequence, to reduce Nitrogen excretion from animal husbandry in the environment. As L-Lysine, L-Threonine is 100% digestible just like L-Lysine so its utilization by the animal is far greater than that of protein-bound threonine from vegetable proteins.

CHAPTER 3

3.0 MATERIALS AND METHODS

3.1: Location of Study

This experiment was conducted at the University of Zambia, Field station Department of Animal Science, Lusaka province, Zambia.

3.2 Plant Material Preparation

Vigna unguiculata (cowpea) seeds were used as the main source of protein in the treatment diet and maize No. 3 meal was used as the energy source. The dry cowpea seeds were boiled in water for 15 minutes as treatment against anti-nutritional factors and were then dried for 7 days prior to grinding. The dried cowpea was ground using a Hammer mill through a 3 mm screen, and stored in polyethylene bags.

3.3 Experimental Procedure, Dietary Treatments and Designs

Hundred day old unsexed Cobb 500 broiler chicks were used in the experiment using the deep litter system of management. The chickens were fed using the two phase system that is on starter and finisher feed. The chickens were assigned to three dietary treatments, each with three replications and each replication having eleven birds. Thus, a total of 9 experimental units were used. The birds were offered *ad libitum* feed and fresh water throughout the experiment. A completely randomized design (CRD) was used. The experimental treatments were as follows:

Treatment 1: Broiler chickens fed a soya bean meal with crude protein of 22% starter feed and 19% finisher without cowpea and threonine Supplementations. The feed were formulated using Zambia Bureau of standards (ZABS) recommendations for broiler feed.

Treatment 2: Broiler chickens fed a cowpea meal with crude protein of 19% starter feed and 19% finisher feed without threonine supplementation.

Treatment 3: Broiler chickens fed a cowpea meal with crude protein of 19% starter feed and 18% finisher feed supplemented with threonine.

Table 2: Treatments and Dietary Inclusion levels of CP and Threonine

Treatment	Crude Protein Level (%)		Threonine Level (%)	
	Starter feed	Finisher feed	Starter feed	Finisher feed
Soyabean+(met, lys)	22	18	0.00	0.00
Cowpea + (met, lys,)	19	19	0.00	0.00
Cowpea +(met, lys and Threo)	19	18	0.73	0.65

Met=Methionine, Lys=Lycine, Threo=Threonine

3.4 Data Collection

3.4.1 Feed intake

The feed intake was measured daily by weighing the feed given to the chickens per day.

3.4.2 Live weight

Initial live weight of the chicks was measured at the start of the experiment. Thereafter live weight of the chickens was taken weekly.

3.5 Proximate Analysis

Cowpea sample were taken to the laboratory for proximate analysis using procedure outlined in the University of Zambia Animal Nutrition laboratory manual for Animal Science Department Samples of raw and boiled cowpea where were analyzed in the laboratory for crude protein, moisture content, ash content, Calcium, ether extract and phosphorus.

Starter and Finisher feed was formulated using boiled cowpea using the Zambia Bureau of Standards (ZABS) recommendations for broilers.

Table 3: Proportions and Ingredients used in the Feed Formulations

Ingredients	Treatments (%)					
	Soya bean + (met,lys)		Cowpea + (met, lys,)		Cowpea +(met, lys and Threo)	
	starter	finisher	starter	finisher	starter	Finisher
No. 3 Maize Meal	52.65	62.71	20.53	28.7	19.0	27.2
Soya bean meal	42.35	33.29	-	-	-	-
Cowpea meal	-	-	-	68.3	76	68.8
DCP	1.09	1.13	0.966	1.38	0.982	1.38
Limestone	0.198	1.34	0.386	0.166	0.365	0.155
Lysine	1.199	0.874	1.281	0.95	1.28	0.95
Methionine	0.134	0.072	0.416	0.310	0.419	0.315
Threonine	-	-	-	-	0.726	0.651
Salt	0.3	0.3	0.3	0.3	0.4	0.3
Broiler premix	0.4	0.4	0.4	0.4	0.3	0.4

3.6 Statistical Analysis

The feed intake and the live weights gains were used to calculate the feed conversion ratio (FCR). Feed conversion ratio was calculated as the total amount of feed consumed divided by the weight gain of live birds. The three parameters, feed intake, live weight and feed conversion ratio were entered into excel and was used to analyze the data using Genstat version 14.

CHAPTER 4

4.0 RESULTS AND DISCUSSION

4.1 Proximate Analysis Results

The chemical composition of raw and cooked cowpeas is presented in Table 4.1. The results of proximate analysis showed that raw cowpea had higher CP than cooked cowpea. Ash andCa content reduced in boiled cowpea. This could be as a result of tap used for boiling cowpeas contains Ca. ME, P and EE levels increased in boiled cowpea. The levels of ME and CP found by Chakam (2010) were higher in boiled cowpeas. These differences could be attributed to different cowpea cultivars and methods of treating cowpea to remove ant-nutritional factors.

Table 4: Proximate Analysis Results

Proximate analysis	Raw cowpea	Boiled cowpea
%M	9.36	9.06
%DM	90.64	90.94
%CP	20.83	22.66
%Ash	4.50	7.06
%Ca	0.40	0.70
%P	0.29	0.25
EE	1.52	1.42
ME (Kcal/Kg)	2960.7	2748.9

4.2 Birds' performance

Table 5: Birds' Feed Intake, Live Weight and FCR Means.

Treatment	Mean feed intake (Kg)	Mean live weight Gain (Kg)	Mean feed conversion ratio (FCR)
Soyabean+(met, lys)	3.943	1.863*	1.78*
Cowpea + (met, lys,)	3.161	1.733*	1.63*
Cowpea +(met, lys and Threo)	2.828	1.610*	1.88*
Grand Mean	3.311	1.73	1.76
%C.V	5.7	16.7	21.3

*Key: * = Non significant differences in the treatment means at P < 0.05.*

Met=Methionine, Lys=Lycine, Threo=Threonine

Results of the effect of dietary supplemented cowpea meal with selected amino acids are presented in table 4.2. There were no significant differences *($p<0.05$)* on the mean live weight of the birds among the treatments.

There were no significant differences in the mean feed conversion ratio *($p<0.05$)* among the treatments.

The results however, showed significant differences *($p<0.05$)* in mean feed intake among the treatments. The highest feed intake was in treatment 1, followed by treatment 2 and the least in treatment 3. The lower mean feed intake in treatment 2 and 3 could be due to the dust nature of the feed. The higher mean feed intake in treatment 1 could have been to the fact that soya-No.3 meal feed is palatable to the birds. Lower energy levels than recommended by ZABS could be also the reason for higher feed intake because broiler chickens eat primarily to satisfy their energy requirements *(Scott et al., 1982)*, and hence feeds lower in energy levels will give higher feed intake in order to meet their energy requirements and hence the birds have to eat more to meet their energy requirements. The highest feed intake was expected in treatment 2 and 3 because the energy levels were much lower. However, this was not the case probably because of dustiness nature of the feed which reduced the palatability of the feed in treatment 2 and 3 and this affected the performance of the birds. This affected the performanceof the bircs in treatment 2 and 3 negatively. The performance of the birds in treatment 2 and 3 can also be attributed to the presence of residual quantities of anti-nutritional factors in the cooked cowpea.

Chakam (2010) demonstrated that as the inclusion level of cowpeas increased above 20%, there was a rapid linear drop in weight gain as a result of residual quantities of anti-nutritional factors. This suggestion was, earlier reported by other researchers.

Treatment of the cowpea could also have an effect on the bird's performance. There were variation in temperature and time the cowpea was subjected to heat. A longer cooking time could probably have been more efficient to deactivate the anti-nutritional factors and thereby reducing their residual effect. Pressure-cooking method of cowpea treatment is better because there is a better control of the temperature and this could have improved the nutritional value of the grain (*Chakam, 2010*).

The performance of the birds was also affected by Mareks disease which affected feed and water intake of the birds. The larger proportion of the affected birds was in treatment 3(lower CP Cowpea and threonine supplementation) and fewer cases in treatment 1 (soyabean meal without threonine and 2 (lower CP Cowpea without threonine).

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study was conducted to evaluate the effect of low CP supplemented with threonine as a third limiting amino acid in the production of broilers.

It can be concluded that low CP diet of cowpea supplemented by threonine can be used in broiler production without negatively affecting the production performance (Feed intake, live Weight and FCR) of the birds.

Vignaunguiculata contains low amounts of CP compared to soya beans. However, supplementation of lower CP of *Vignaunguiculata* with threonine had a positive effect on the growth rate, FCR and a reduction in the feed intake of the chickens.

Based on the nature of results of the present study, it can be concluded that the nutritive value of cultivated cowpea as a non-conventional protein source for poultry is satisfactory and has a positive effect on broiler chickens' performance.

5.2 Recommendations

The research shown that *vagnaunguiculata* has the potential to be used in the diet of broilers. This is evident from the findings. However, it is recommended that more research in the same field is done so that the best results are obtained. There is need to pellet the feed so that dust should not restrict the cowpea formulated feed. There is also need to use more number of birds to reduce on error and increase accuracy. Finally, there is need to balance the energy level in the feed. This will help to determine the fate of cowpea and threonine in the feed industry of broilers.

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